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Tracing the origins and processes of groundwater salinization in coastal aquifers with a multi-isotopes approach. Example of Recife, Northeast of Brazil

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Abstract

The Recife Metropolitan Region (PE, Brazil) is a typical "hot spot" illustrating the problems of southern countries on water issues inducing high pressures on water resources both on quantity and quality in the context of global social and environmental changes. By focusing on the groundwater geochemistry in a coastal multilayer aquifer, this work aims at investigating the sources and processes of salinization. Two different Precambrian blocks separated by a large lineament area constitute the site basement. The sedimentary fillings of the two basins present different origins that were distinguished by the Sr isotope composition. The northern deep Beberibe aquifer displays very high $^{87}\text{Sr}/^{86}\text{Sr}$ with a large range of values (0.7102-0.7233) illustrating the main continental origin of sediments whereas the southern deep Cabo aquifer showed lower values (0.7097-0.7141) indicating the contribution of the marine sedimentation. Although sulfate isotopes, Electrical Conductivity and Cl contents indicate a mixing with seawater for some samples of the deep Cabo and Beberibe aquifers, all $^{87}\text{Sr}/^{86}\text{Sr}$ values are above the present-day seawater composition. This can be related to the complex local history of transgression/regression phases that induced alternatively salinisation and freshening with gains and losses of cations and Sr, together with water-rock interactions. $\delta^{18}\text{O}$ - $\delta^2\text{H}$ clearly evidence the local present day recharge in the surficial aquifer, some samples being affected by in situ evaporation processes and/or recharge with evaporated water from dams used for water supply. The deep aquifers display a high range of B (20-600 $\mu\text{g/L}$) and $\delta^{11}\text{B}$ (6.7-68.5‰) with some of the highest values known to date. Multiple sources and processes affect the B behavior, among which mixing with saline water, B sorption on clays/organic matter and mixing with wastewater. The surficial aquifers are locally salinized possibly due to present seawater intrusion, and highly contaminated with wastewater.